The Interaction of Serotonin and Alcohol May Cause Depression

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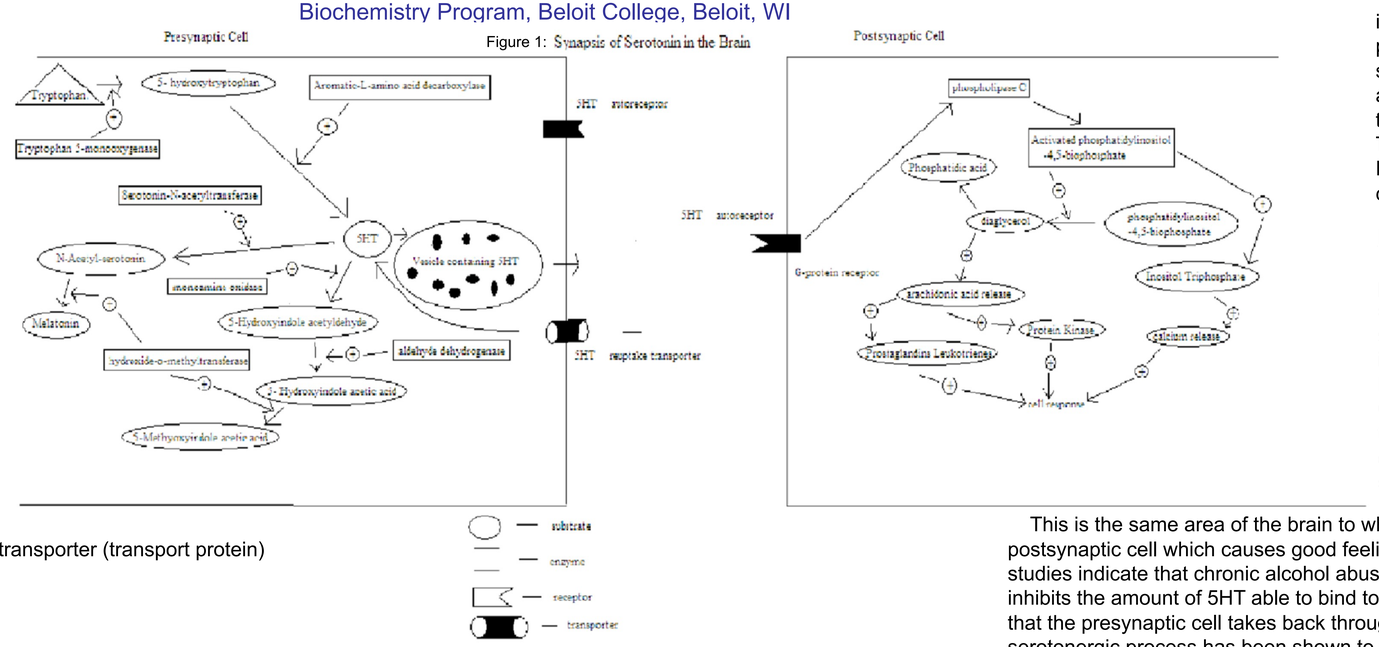
ABSTRACT:
Studies have shown a strong correlation between alcohol consumption and depression. Serotonin (5HT) is a key neurotransmitter in depression. I hypothesized that there is a negative interaction between the chemical processing of 5HT and alcohol in the brain, which causes depression. I found this link through different analyses. Diagrams of the chemical processes are presented with descriptions and important facts from peer-edited studies. 5HT processing in the brain has a genetic connection to the 5-HTT serotonin gene. I also examined how alcohol affects the brain. Although 5HT and alcohol consumption interact to promote depressed moods, I found no scientific study proving that the two chemicals interact to cause long-term depression. Acute intoxication with alcohol causes an overabundance of 5HT production, which travels to the frontal lobe of the brain causing temporary feelings of euphoria. However, studies indicate that chronic alcoholics have fewer receptors and therefore do not receive the proper cellular response to 5HT. As a result, individuals have more anxiety-prone, impulsive, and depressed moods, which makes them more prone to become alcoholic. However, alcohol is not processed in the brain, and affects different areas of the brain from those where 5HT is produced.

Abbreviations: EtOH - alcohol 5HT - serotonin 5HTT - serotonin transporter (transport protein)

Figure 1: Synapsis of Serotonin in the Brain



INTRODUCTION:

The figure above shows the pre- and postynaptic cell where serotonin (5HT) acts in the brain. The serotonergic system is located in the raphe nuclei in the brain stem. It is comprised of seven 5HT receptor families with 14 receptor subtypes (identified thus far). This is one of the most complex families of neurotransmitter(NT) receptors. The dysfunction of this system has been indicated in the pathophysiology of depression. This system is targeted in its treatment.

What determines the functionality of the serotonergic chemical process is the 5-HTT gene, the 5HT transporter gene. Each person has two copies in their DNA. The gene has two alleles: long and short. The two represent dominant and recessive genes, and are determined by the number of proteins that comprise them.

5HT is synthesized in presynaptic neurons beginning with the amino acid, tryptophan. The enzyme tryptophan hydroxylase adds a hydroxyl group to form 5-hydroxytryptophan. A second enzyme, aromatic amino acid decarboxylase, removes carbon dioxide from it to form 5-hydroxytryptamine (5HT) also known as serotonin.

The amount of 5HT released into the synapse is regulated by the 5HT receptors. These receptors, known as agonists and antagonists, are sensitive to the amount of 5HT in the synapse and thus control the synthesis and release of 5HT in the brain. The 5HT is then released into the space between two cells called the synapse. The 5HT then binds to the receptors in the postsynaptic cell and after a series of chemical reactions causes the cellular response. When the reuptake transporters of the presynaptic cell take back too much 5HT before it can attach itself to the receptors in the postsynaptic cell, the proper cellular response cannot occur and the individual is more prone to anxiety and depression.

Alcohol (ethanol or EtOH) is a drug, more specifically a depressant. When EtOH is first consumed, it affects different areas of the brain. First, it affects the frontal lobe of the cortex, causing impaired reasoning and judgment, and disinhibition,. Next, it affects the vision and speech areas of the brain, which causes blurred vision and slurred speech. It also affects the parietal lobe, specifically the motor cortex, which deals with movement. EtOH inhibits full function of the body and slows reaction times. It affects the cerebellum to affect coordination. With heavy drinking, the conscious parts of the brain are sedated to the extent that the individual passes out to prevent death caused by over-consumption.

Since EtOH acts as a depressant and there are many individuals who suffer from depression and alcoholism, it is suggested that there is a correlation between EtOH consumption and serotonergic processes. Therefore, I hypothesize that there is a direct correlation between EtOH consumption and serotonergic processes in the brain that causes depression in its many forms in a variety of individuals.

http://medicineworld.org/images/blogs/alcohol-422270.jpg

METHOD:

To study the correlation between 5HT and EtOH intake, it is necessary to understand the chemical processing and genetics of 5HT in the brain. I also studied the effects that take place on the human body and mind to put this information into a larger context. I then studied the effects that EtOH has on the brain. Then I explored the relationship that 5HT has to EtOH. Finally, I read many peer-edited studies concerning the correlation between the two.

RESULTS:

Overall the relationship between the chemical processes of 5HT and EtOH in the brain are not as directly correlated as previously thought. I found no scientific evidence to prove that there is a chemical interaction in the brain between the two chemicals. However, there is a complex relationship linking the two. One of the effects of EtOH occurs in the frontal lobes of the brain. The alcohol sedates this part of the brain to cause temporary feelings of euphoria brought on by disinhibition.

This is the same area of the brain to which 5HT travels after the cellular response in the postsynaptic cell which causes good feelings and promotes a balanced mental state. However, studies indicate that chronic alcohol abusers have fewer transporters on the postsynaptic cell. This inhibits the amount of 5HT able to bind to postsynaptic receptors and increases the amount of 5HT that the presynaptic cell takes back through the reuptake transporters. This dysfunction of the serotonergic process has been shown to promote feelings of depression and anxiety in large populations of individuals. Thus it can be determined that alcohol does have an effect on depression through inhibiting the functionality of the serotonergic process in the brain.

DISCUSSION:

After careful analysis of the given information, I have found that although there is no direct chemical interaction between EtOH and 5HT, there is a relationship. This interaction is negative as the two perpetuate the harmful effects of each other. It is concluded that individuals diagnosed with depression should not drink more than the daily recommended intake of EtOH as it is detrimental to his or her mental health. This is crucial for all people, including college students, because many consume large amounts of EtOH, which will ultimately damage the 5HT receptors in the brain, causing some form of depression. **It is evident that when an individual is diagnosed with depression (**due to the dysfunction of the serotonergic process**), they should limit or omit alcohol intake to prevent promotion of depression.**

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For additional information on the genetic component of this interaction, please see:

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